RESEARCH

Cariboo Forest Region

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EXTENSION NOTE #5
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Identification and Management of Summer Frost-Prone Sites in the Cariboo Forest Region

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FRDA Report 157 provides a framework for the management of frost-prone sites and includes a field guide for the identification of sites with a high frost hazard.

INTRODUCTION

Forestry field staff in the Interior of BC have become increasingly aware of frost damage to conifer seedlings. Frost incidents are surprisingly common throughout the Interior, damaging or killing buds, harming tree form, and making trees more susceptible to potential pathogens. Frosts occur in nearly all the Cariboo Region's biogeoclimatic subzones between bud flush and hardening off, with differences in occurrence among microsites within each subzone.

FROST PROCESSES

Frost occurs as a result of two processes:

Radiation - the cooling of the ground surface on calm, clear nights through radiation of heat stored in the soil, and air at the ground surface, toward the atmosphere.

Local advection - the downslope flow of cold air and subsequent concentration in low-lying areas.

Frost occurrences depend on a variety of factors:

Atmospheric: air temperature, humidity, cloud cover, wind speed.
Site: Elevation, slope position, slope angle, topography, latitude.
Vegetation cover: height, density, species.
Soil: composition and surface material.

FROST HAZARD ASSESSMENTS

The report defines and describes hazard classes, ranging from

RESEARCH Section, Ministry of Forests, Cariboo Forest Region
200 – 640 Borland Street, Williams Lake, BC V2G 4T1 Phone (250)398-4345
Fax (250)398-4380 http://www.for.gov.bc.ca/cariboo/research/research.htm

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very low to very high, for Douglas-fir, spruce and lodgepole pine, giving predictions of damage and mortality for each of the three species. The hazard classes for a recently clearcut site can be determined from biogeoclimatic unit, slope position and slope gradient.

Differences in frost susceptibility for the three species are evident: Douglas-fir is the most frost-susceptible, followed by spruce and pine. Three classes for damage (none, moderate, severe) and mortality (none, limited, extensive) are described.

The four-page field guide insert included with the report includes keys to frost hazard determination, definition of hazard classes, and a listing of factors that increase or decrease frost hazard.

The prediction of frost during the growing season and the management of frost-prone sites are key aspects of the report. The report offers suggestions to minimize frost damage for successful regeneration through:

- site preparation,
- species and stock type selection,
- harvest methods,
- nurse crops, and
- microsite selection.

CONTACT

For more information, contact

Ordell Steen (398-4409), or
Ray Coupé (398-4717).

REFERENCE

Identification and Management of Summer Frost-prone Sites in the Cariboo Forest Region, by Ordell Steen, Robert Stathers and Ray Coupé. FRDA Report 157. December 1990.

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FACTORS THAT AFFECT FROST OCCURRENCES

CATEGORY	FACTOR	EFFECT ON FROST OCCURRENCE
Atmosphere	Air temperature	Colder air requires less radiative heat loss to cool to freezing. Cold air is denser than warm air and therefore flows downhill and ponds in low areas.
	Cloud cover	Clouds absorb longwave radiation and radiate it back to the ground surface.
	Wind speed	Wind mixes the radiatively cooled air near the ground with warmer overlying air.
Site	Elevation	Higher elevation sites are colder than lower elevation sites, and radiatively cool more rapidly at night.
	Slope position	Slope position affects the size of the potential cold air source and receiving areas.
	Slope angle	Slope angle affects the rate of cold air drainage and the amount of air mixing.
	Topography	Topography affects cold air dispersion and accumulation. Convex slopes are usually less frost-prone than gullies, concave slopes, or flat areas where cold air either accumulates or drains slowly.
	Latitude	Latitude affects the number of nighttime hours when the ground surface can radiatively cool, particularly in the early and late summer.
Vegetation Cover	Height and density	Taller and denser vegetation canopies reduce radiative heat loss from the ground surface and thereby reduce the rate of ground surface cooling at night.
	Species	Vegetation cover with broad, flat leaves reduces radiative heat loss more than canopies with thinner, vertically-oriented leaves.
Soil	Composition	Soil texture, organic matter, and bulk density affect the storage and release of heat in soil and thus the temperature of the ground surface at night.
	Surface material	Organic surfaces store less heat than do mineral surfaces and cool to lower temperatures under the same conditions.